



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/707,726	01/07/2004	Toshiharu Furukawa	FIS920030316US1	1725

32074 7590 06/27/2005

INTERNATIONAL BUSINESS MACHINES CORPORATION
DEPT. 18G
BLDG. 300-482
2070 ROUTE 52
HOPEWELL JUNCTION, NY 12533

EXAMINER

HU, SHOUXIANG

ART UNIT	PAPER NUMBER
----------	--------------

2811

DATE MAILED: 06/27/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

Office Action Summary	Application No.		Applicant(s)	
	10/707,726		FURUKAWA ET AL.	
	Examiner		Art Unit	
	Shouxiang Hu		2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 April 2005.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5,7-10 and 15-20 is/are pending in the application.
- 4a) Of the above claim(s) 17-20 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5,7-10,15 and 16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

Claims 1-5, 7-10, 15 and 16 are objected to because of the following informalities and/or defects:

In claim 1, line 1, the term of "circuit an" should read as: --circuit on--

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-5, 7-10, 15 and 16 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matters which were not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. These claims recite the subject matters of "introducing a chemical constituent into the nanotube material during formation of only one of the top and bottom of the nanotube to produce an electrical effect during operation", which are critical or essential to the practice of the invention as defined in these claims. However, the disclosure lacks an adequate description regarding what is the recited chemical constituent; how it is introduced into the recited

Art Unit: 2811

nanotube's bottom or top section inside the recited aperture; and how such process steps could be controllable.

Applicant's arguments in response to the above rejection have been fully considered but they are not persuasive, as they lack adequate evidence to show that the concerns raised in the above rejection could be readily addressed in the art. And, the example of Roesner about doping carbon nanotube with boron and nitrogen, as cited by the applicant, is not particularly relevant to the raised concerns, since these dopants in Roesner are intended to be used to form an insulating nanotube (see col. 1, line 64, through col. 2, line 4, in Roesner), instead of forming a semiconducting one as intended in the instant invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5, 7-10, 15 and 16, insofar as being in compliance with 35. U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Roesner (Roesner et al., US 6,740,910) in view of Fitch (Fitch et al., US 5,414,289).

Roesner discloses a method of forming an integrated circuit on an substrate, including forming a set of vertical field effect transistors each having a channel a carbon nanotube (see Figs. 1A-1C), comprising the steps of: forming a first conductive layer

Art Unit: 2811

(102) on a substrate (101); forming a first insulating layer (103); forming a gate layer (a portion of layer 104 that is on the first insulating layer 103), wherein such a gate layer as shown in Figs. 1A-1C naturally has a thickness that is naturally within a certain thickness tolerance; forming apertures (106), having substantially vertical interior walls, through the gate layer and the first insulating layer, the bottom of the aperture exposing the first conductive layer; forming insulating liners (109) on the walls of the apertures; forming a catalyst (107); forming a semiconductive carbon nanotube (108) in each of the apertures, the bottom of the carbon nanotube being in electrical contact with the first conductive layer; and forming an electrical contact (110) on a top of the carbon nanotubes.

Although Roesner does not expressly disclose that the method can further include the step of introducing appropriate the chemical dopant in the channel-forming nanotube for forming only one LDD-type region in the nanotube, one of ordinary skill in the art would readily recognize that such LDD region can be desirably formed in FET for improving the channel performance by suppressing short channel effects therein, as further evidenced in Fitch (see the only LDD region 32 in Figs. 4, 10 and/or 11).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make vertical FETs using the method of Roesner with single LDD region being introduced into the nanotube, per the teachings of Fitch, so that a method for forming an IC having vertical FETs with improved channel performance would be obtained.

Regarding claim 2, the method of Roesner including forming at least two FETs in a row.

Regarding claims 4 and 8, the liner or the gate insulating layer (109) in Roesner is formed thorough oxidation of the gate layer material (see col. 6, lines 24-31); and such a oxidation process step naturally involves an temperature-elevated environment.

Regarding claims 5 and 10, it is noted that one of ordinary skill in the art would readily recognize that the insulating liner functions as a gate insulating layer, which can also be readily formed through CVD for obtained good gate dielectric property, as evidenced in the prior art such as Yang (US 6,033,941; see col. 1, lines 41-45), and/or further in Fitch (see col. 4, lines 2-12).

Response to Arguments

Applicant's arguments filed on 4-21-2005 regarding the claim rejections under 35 U.S.C. 112 have been fully considered but they are not persuasive. And, response to these arguments has been incorporated into the claim rejections set forth above in this office action.

Applicant's other arguments with respect to rejected claims have also been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-

Art Unit: 2811

1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SH
June 23, 2005



SHOUXIANG HU
PRIMARY EXAMINER